THIS CHAPTER IMPLEMENTS STANAGs 3281 AND 3619 AND QSTAG 585.

CHAPTER 4
HELICOPTER LANDING ZONES

Helicopter landing zones contain one or more helicopter landing sites. Each landing site has a control center and, in most cases, a manned or unmanned release point (STANAG 3619).

Section I. SELECTION OF LANDING SITES

The ground unit commander coordinates with the supporting aviation unit to select helicopter-landing zones that can support the ground tactical plan.

4-1. REQUIREMENTS

Minimum landing space requirements and minimum distance between helicopters on the ground depend on many factors. If the aviation unit SOP does not spell out these requirements, the aviation unit commander works with the pathfinder leader. The final decision about minimum landing requirements rests with the aviation unit commander. In selecting helicopter-landing sites from maps, aerial photographs, and actual ground or aerial reconnaissance, he considers the following factors:

a. **Number of Helicopters**. To land a large number of helicopters at the same time, the commander might have to provide another landing site(s) nearby. Or, he can land the helicopters at the same site, but in successive lifts.

b. **Landing Formations**. Helicopter pilots should try to match the landing formation to the flight formation. Pilots should have to modify their formations no more than necessary to accommodate the restrictions of a landing site (Figure 4-1, page 4-2). However, in order to land in a restrictive area, they might have to modify their formation somewhat.

c. **Surface Conditions**. Pathfinders choose landing sites that have firm surfaces. This prevents helicopters from bogging down, creating excessive dust, or blowing snow. Rotor wash stirs up any loose dirt, sand, or snow. This can obscure the ground, especially at night. Pathfinders remove these and any other debris from landing points, since airborne debris could damage the rotor blades or turbine engine(s).

d. **Ground Slope**. Pathfinders choose landing sites with relatively level ground. For the helicopter to land safely, the slope should not exceed 7 degrees (Figure 4-2, page 4-3). Whenever possible, pilots should land upslope rather than downslope. All helicopters can land where ground slope measures 7 degrees or less.

(1) ***Observation and Utility Helicopters***. When the slope exceeds 7 degrees, observation and utility helicopters must terminate at a hover to load or off-load personnel or supplies.

(2) ***Large Utility and Cargo Helicopters***. When the slope measures between 7 and 15 degrees, pathfinders advise the pilots of large utility and cargo helicopters.

NOTE: To determine slope in percentage or degrees, express all measurements in either feet or meters, but not both. If the map sheet expresses elevation in meters, multiply by three to convert meters into feet. If the map sheet expresses elevation in feet, divide by three to convert to meters.

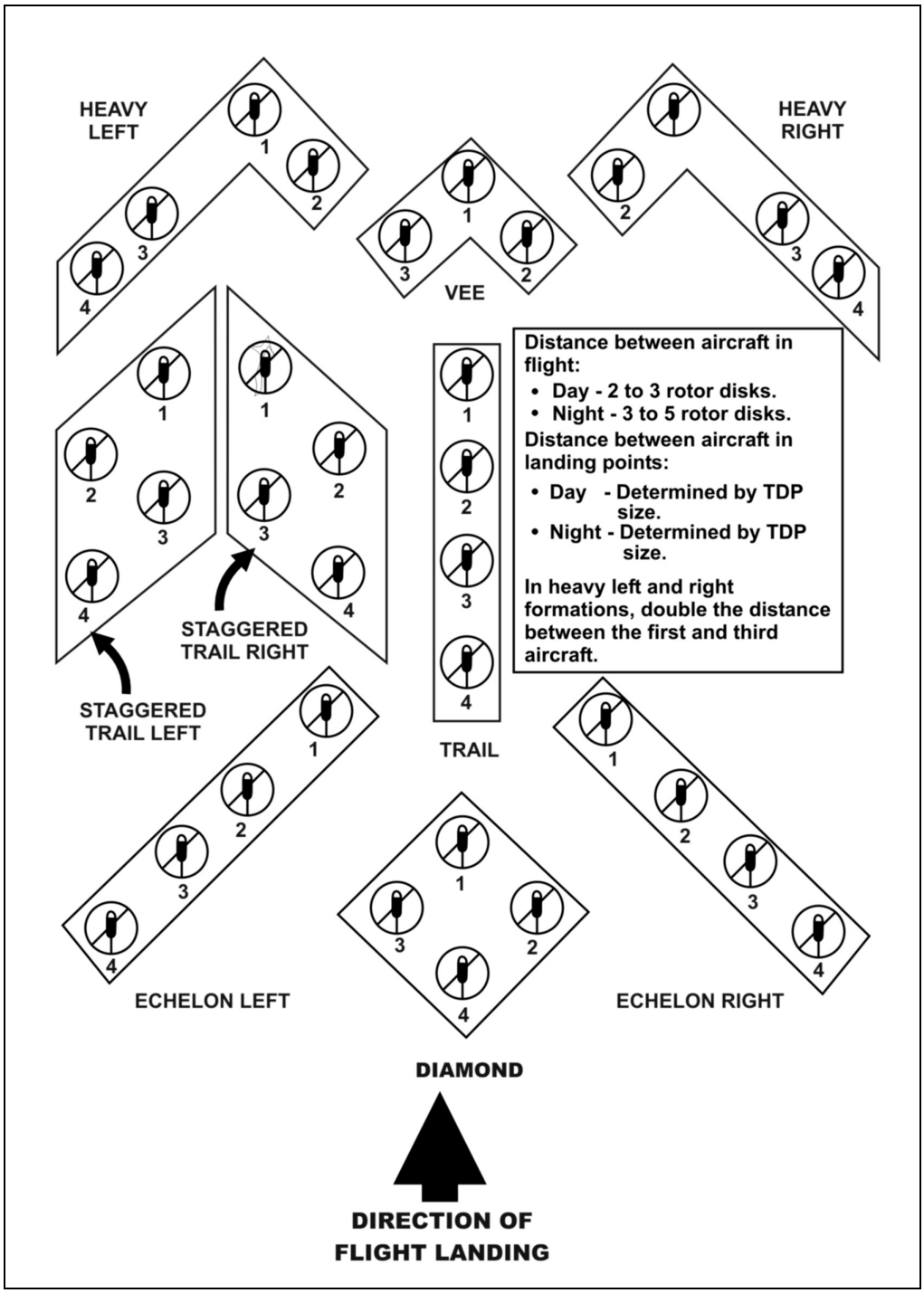

Figure 4-1. Standard flight and landing formations.

e. **Approach and Departure Directions**. To land or to take off, especially at night, the helicopter pilot generally chooses the approach or departure path with the lowest obstacles. Ideally, this allows him to fly into the wind. Depending on the helicopter's capabilities, if only one direction offers a good approach, or to make the most of available landing area, the pilot might be able to land with a crosswind of 0 to 9 knots or

a tailwind of 0 to 5 knots. When wind speeds exceed 9 knots, the pilot must land into the wind. The same considerations apply to departures from landing sites.

f. **Prevailing Wind**. Except when the crosswind velocity exceeds 9 knots during a landing, the prevailing wind requires less attention than it does on the approach and departure routes. The wind affects smaller aircraft more than larger, more powerful ones.

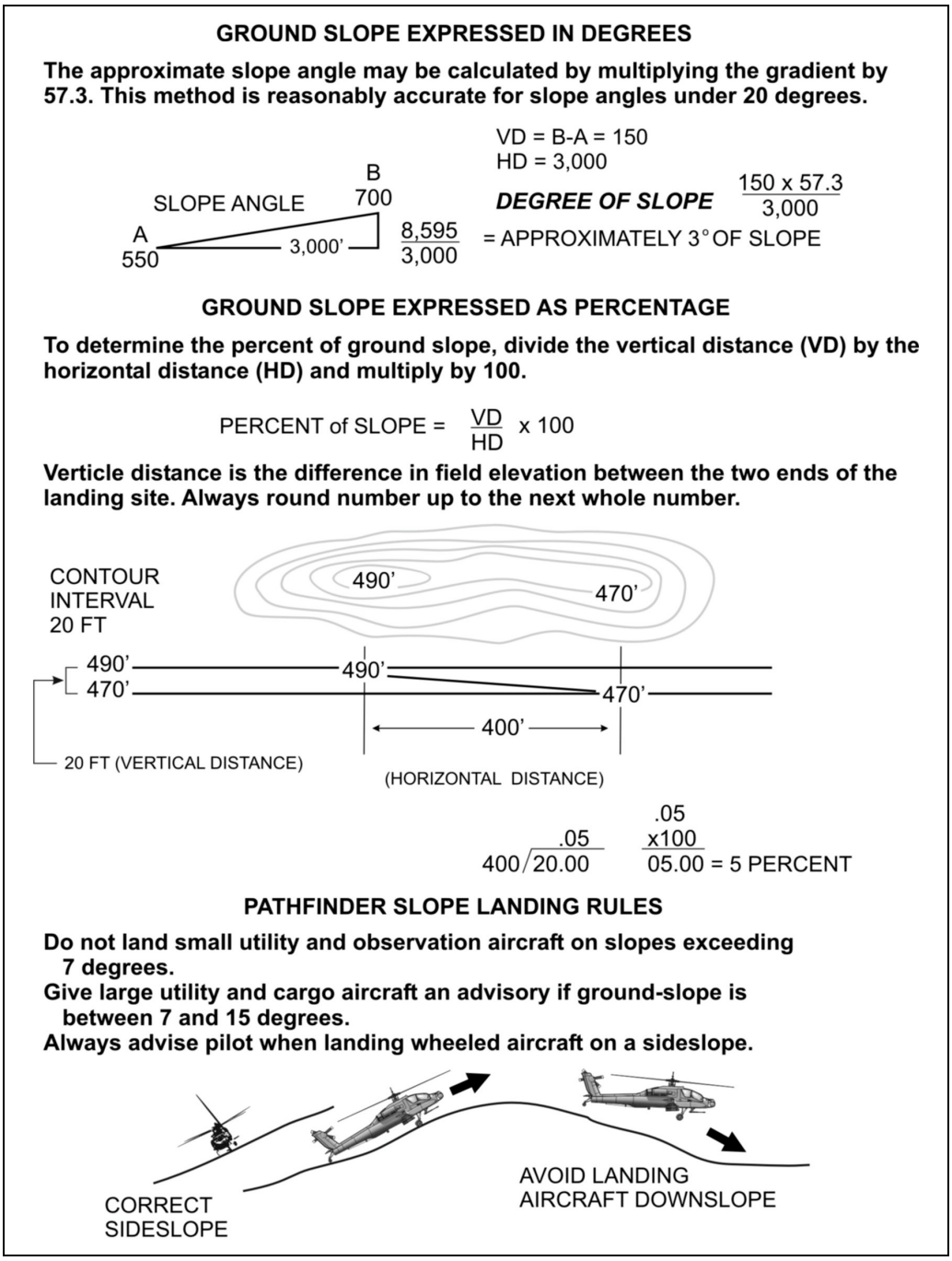

Figure 4-2. Determining ground slope.

g. **Density Altitude**. Altitude, temperature, and humidity determine the density altitude. Planners should try to remember that as the density altitude increases, the size of the LZ also increases. High, hot, humid conditions decrease lift capabilities.

h. **Loads**. When fully loaded, most helicopters can neither climb nor descend vertically. They need a larger area and better approach or departure routes than when they carry lighter loads.

i. **Obstacles**. Landing zones should have no tall trees, power lines, or similar obstructions on the approach and departure ends of the landing site. Pathfinders must remove any obstacles within the landing site. This includes any rocks, stumps, and holes; and thick grass or brush over 0.45 meter (18 inches). Planners figure on an obstacle ratio of 10 to 1 (ten to one). That is, if a helicopter must approach or depart directly over a 10-foot tall tree, then the landing point must have 100 feet of horizontal clearance.

NOTE: The helicopter unit commander makes the final decision on minimum landing requirements. He bases his decision on the effects of air density, slope, and surface conditions. He explains these requirements verbally during early mission planning.

4-2. ALTERNATE SITES

Enemy action, unfavorable terrain, or changes in the tactical or logistical situation can require alternate landing sites. The ground unit commander usually selects these to support the tactical plan. He (or his representative) decides when to use them based on the recommendations of the aviation unit commander and the pathfinder on the site. The commander uses the fastest means to get instructions for using alternate sites to the pathfinders. Neither pathfinder nor aviation unit commanders can shift to an alternate LZ(s) unless the supported ground unit commander has delegated that authority to them.

4-3. LANDING POINTS

The pathfinder leader designates areas or points that can support the weight of a helicopter. A helicopter requires a level, clear, circular area that measures between 25 and 100 meters in diameter. The type of helicopter determines the exact size of the area. The ground unit and pathfinders work together to clear from the landing point area all trees, brush, stumps, or other obstacles that could damage the helicopter. Usually, a helicopter requires a larger area for landing in the dark than in daylight. The size of the landing area also depends on the type of helicopter, the nature of the load, the climate, and visibility.

a. **Choose a Hard Surface**. Pathfinders choose a landing point with a "hard surface." That is, the surface of the landing point must allow a fully loaded helicopter to land, restart, and leave again, all without sinking into the ground.

b. **Clear to Ground Level**. Pathfinders must clear the entire landing point of any loose material that the rotors could blow up. The term is "cleared to ground level." Unless a fire risk exists, they need not clear grass less than 0.3 meter (1 foot) high, as long as the field is level. They can cut down on dust by wetting down dry dirt. They can reduce snow to reveal hazards, then pack it down firm, which will also reduce the amount blowing around.

c. **Clear Around Obstacles**. Ground troops must do everything they can to improve landing point surfaces so aircraft can land. However, even if pathfinders cannot clear ground obstructions, they can perform some helicopter operations without the helicopter

landing. However, they must still clear and mark the area just as they would if the helicopter were going to land. Helicopters hover above the ground obstructions that prevent them from landing.

d. **Measure the Shortest Distances Between Landing Points**. In a landing site, pathfinders measure the minimum distances between landing points, from center to center. When aircraft sizes vary, pathfinders separate landing points by the most generous measure, allowing 100 meters from center to center of the landing points (Figure 4-3, page 4-6). At the least, these distances must measure--

(1) Size 1 Landing Point. 25 meters.
(2) Size 2 Landing Point. 35 meters.
(3) Size 3 Landing Point. 50 meters.
(4) Size 4 Landing Point. 80 meters.
(5) Size 5 Landing Point. 100 meters.

Section II. ORGANIZATION AND DUTIES

The commander task organizes the pathfinder element to set up and operate the installations required by the supported unit's tactical plan. They may set these up within a single LZ or separate them widely throughout a large AO. The pathfinder leader normally stays at the most important site. To set up and operate one helicopter LZ, the commander task organizes the pathfinder element into two working parties-a reconnaissance party and a marking party. Each site requires its own landing site party. The control center party and the release point party provide the same function for LZs or DZs.

4-4. CONTROL CENTER

The CC coordinates aircraft in and around an LZ or DZ and promotes a safe, orderly, and speedy flow of air traffic. Upon arrival in the area, the pathfinder leader selects the exact location of the CC. He positions it to allow visual control of aircraft in and around the LZ or DZ.

a. For helicopter LZs, the most desirable CC location is along the aircraft flight route, but displaced from the landing site. This helps prevent enemy EW assets from compromising the actual landing site location, even if the tactical situation dictates that the pathfinder leader remain on the site for control purposes. For an LZ with more than one landing site, or for any LZ during reduced visibility, the pathfinder leader locates the CC where it can act as a manned RP or final approach fix to provide positive navigational assistance to arriving aircraft.

(1) The RP is an established traffic control checkpoint. It is the final navigational checkpoint for aircraft approaching the landing site or approaching air-delivery facilities in an LZ or DZ.

(2) During the air movement phase of an air assault operation, helicopter serials also use the RP as a final coordination point for control of planned ground or aerial supporting fires in and around LZs. The air movement commander staffs the RP only when he expects tough navigational problems. He tentatively chooses its location from maps or from aerial photographic studies. He looks for an easily identifiable point on the planned flight route to the landing site. He looks for a location that will take advantage of long-range electronic and visual navigation aids.

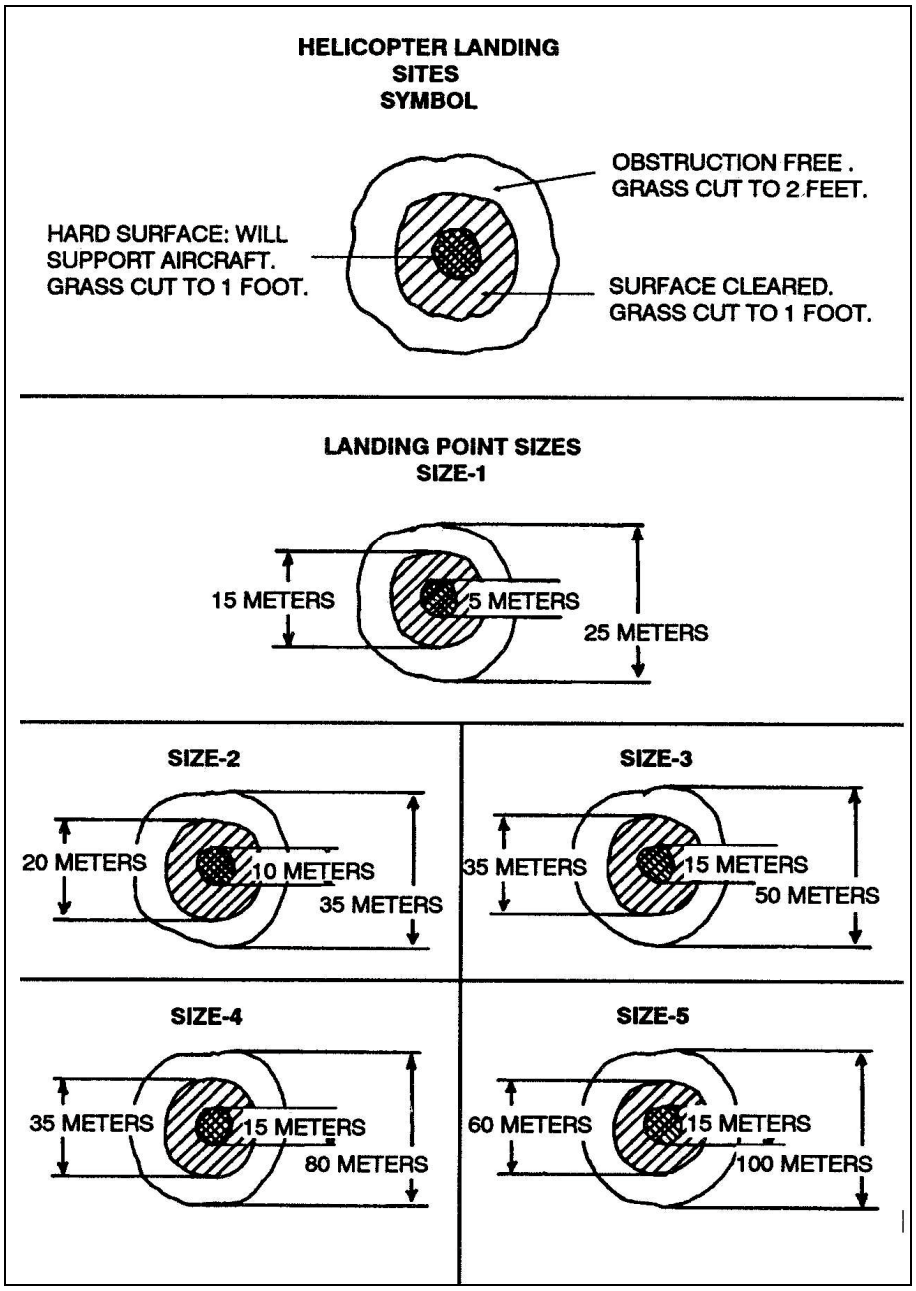

Figure 4-3. Landing points.

b. For single helicopter landing sites within a single LZ, the site itself offers the best location for GTA communication. Especially at night, positioning here allows the pathfinder ATC to observe the final approach of helicopter formations. It helps him make sure pilots align correctly on the required landing direction. It also helps him ensure that they clear any obstacles.

c. The pathfinder leader organizes the control center to meet mission requirements. The control center can consist of a single pathfinder. This soldier can operate the GTA radio for a limited period at a small site, or the control center can consist of the following staff:

(1) ***LZ or DZ Commander***. He supervises aircraft landings and departures, airdrops, and other pathfinder activities in the LZ or DZ. He may also serve as the GTA radio operator.

(2) ***GTA Radio Operator***. He operates the radio used to maintain communications with pilots. He also provides advisories for his airspace, as needed.

(3) ***Internal Net Recorder***. Some situations require pathfinders to set up an internal net to communicate with other pathfinder elements. An internal net recorder (INR) runs this net. The INR can help control aircraft by observing them and recording their arrivals, departures, and loads. He records air traffic to and from the helicopter-landing zone (HLZ) on DA Form 7461-R (Figure 4-4, page 4-8). This form serves as a log or manifest. If an aircraft fails to arrive at its destination, search and medical units can check the applicable DA Form 7461-R and focus their search between the last departing station and the gaining station. The recorder completes the form as follows:

(a) *PFDR Det*. Write the name of the pathfinder detachment operating the LZ.
(b) *Supported Unit*. Write the name of the supported unit.
(c) *Period (DTG).* Write the date and time of the mission.
(d) *Operation*. Write the name of the mission.
(e) *Designation*. Write the name and location of the site.
(f) *Recorder.* Write your name.
(g) *No. A/C.* Write the number of aircraft in the formation.
(h) *Type A/C*. Write the nomenclature of each type of aircraft in the formation.
(i) *Contact Time*. Write the time of the initial contact with the flight commander.
(j) *Call Sign*. Write the flight commander's call sign.
(k) *Time, Arr*. Write what time the aircraft or formation inserted.
(l) *Time, Dep*. Write what time the aircraft or formation extracted.
(m)*Load Type, Ins*. Write what type of load the aircraft inserted.
(n) *Load Type, Ext*. Write what type of load the aircraft extracted.
(o) *Destination*. Write the name of the aircraft's or formation's destination on leaving.
(p) *Remarks*. Write anything else here that you think you need to record.

4-5. LANDING SITE PARTY

The landing site party consists of a site team leader and other pathfinders and attached personnel, as required. A single pathfinder may establish and operate a small landing site for a limited time.

a. **Site Team Leader**. The site team leader reconnoiters, establishes, and operates the landing site. He supervises it and, at any time, may supervise the GTA radio operator. Some of his responsibilities include--

(1) Organizing at an objective rally point.
(2) Reconnoitering to determine--
- Long axis.
- Usable area.
- Ground slope (compute).
- Land heading.
- Best landing formation.

(3) Designating sling-load point(s).
(4) Emplacing and briefing the GTA radio operator.

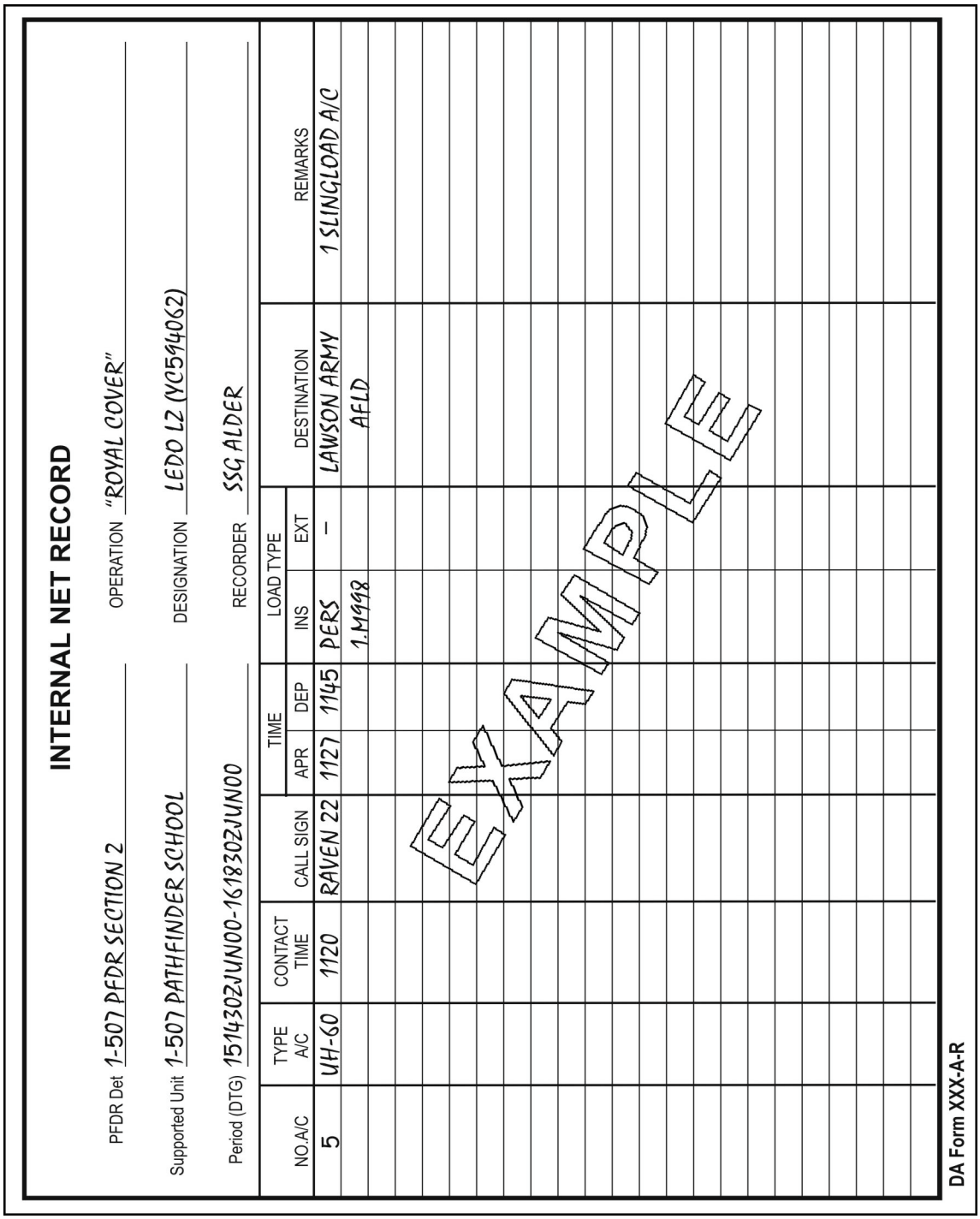

Figure 4-4. Example completed DA Form 7461-R.

(5) Clearing touchdown and sling-load points.
(6) Organizing personnel and loads for air movement.
(7) Clearing or marking obstacles.
(8) Preparing for night and day missions.
(9) Continuing to improve the site.

b. **Extra Pathfinders**. These soldiers operate the GTA radio and the pathfinder internal radio net (if established), position and operate navigation and assembly aids, and clear or mark obstacles. Three factors dictate the number of extra pathfinders employed:

- The size of the landing site.
- The expected density of air traffic.
- The number and type of visual and electronic aids used.
- The tactical situation.

c. **Commander**. The commander can attach other soldiers from supported units to the landing site party. The pathfinders brief and rehearse attached soldiers. Only pathfinders reconnoiter actual landing areas, but attached personnel can--

- Reconnoiter other areas.
- Provide security.
- Help pathfinders set up and operate the landing site.
- Reconnoiter and mark assembly areas.
- Operate assembly aids.

Section III. LANDING SITE OPERATIONS

Before they can start using a landing site, pathfinders need only pick its location and set up communications in it. They continue marking and improving the site continually, until it can support the ground tactical plan.

4-6. COMMUNICATIONS

As soon as they arrive at the landing site, pathfinders set up communications in the GTA net. If needed, they also set up the pathfinder internal net. They monitor these radio nets continuously, unless directed otherwise, until they complete operations at the site.

a. Tactical situation permitting, pathfinders locate each helicopter landing site within ground communication range of the other sites and manned RPs. The range of available radios dictates whether facilities within the LZ can communicate with each other.

b. The commander of the landing site for utility and cargo helicopters quickly reconnoiters the area to determine the exact direction of landing. He calculates an intercept heading from the RP, if necessary. He selects the location of the landing point of the lead helicopter of each flight. Then, he decides if the terrain or situation dictates any change to the planned landing formation. The site commander has pathfinders or other personnel compile landing instructions for transmittal to inbound helicopters. He also has them remove or mark obstacles in or around the site.

4-7. FLIGHT FORMATIONS

Ideally, all helicopters land at the same time in a planned flight formation. The landing site commander includes this information in his landing instructions to the flight leader. Pathfinders lay out the landing site in a location where helicopters will not fly directly over aircraft on the ground. The layout of the site also depends on the landing space available, the number and type of obstacles, unit SOPs, and prearranged flight formations.

4-8. LANDING ZONE AND OBSTACLE MARKING

For daylight operations, pathfinders use only smoke, or some other minimal identification means to mark LZs. For night operations, they use lanterns, field expedients, or both to

show the direction of landing and to mark individual landing points (Figures 4-5 through 4-9, pages 4-11 through 4-15; and Figure 4-10, page 4-16). For daylight and night air assault operations, they mark all obstacles. (Section V provides more detailed information about conducting night operations.)

a. At night, pathfinders can use lights of different colors (except red, which marks obstacles) to designate different helicopter sites or to separate flights within a larger formation. A lighted "T" or inverted "Y" indicates both the landing point for the lead helicopter of each flight and the direction of approach (Figure 4-11, page 4-17). Other lights mark touchdown points for the other helicopters in the flight. Each helicopter should land with its right landing gear or its right skid 5 meters left of the light.

b. For security, pathfinders and the ground unit cover or turn all lights upside down until the last practical moment before a helicopter arrives. Then, they beam the lights in the direction from which the lead helicopter is approaching, and a signalman directs its landing.

NOTE: Because the infrared lights could be too bright for the aircrew member's NVG, he might have to look under it in order to distinguish the colors.

4-9. AIR ASSAULTS

During daylight air assault operations, pathfinders use red-colored panels or other red, easily identifiable means to mark any hard to detect, impossible to remove obstacles such as wires, holes, stumps, and rocks. During nighttime air assault operations, pathfinders use red lights to mark any obstacles within the landing site that they cannot reduce or remove.

a. In most combat situations, the need for security keeps pathfinders from using red lights to mark treetops on the departure end of a landing zone. However, in training or in a rear area landing site, they do use red lights. If they cannot mark obstacles or hazards, they must fully advise aviators of existing conditions by GTA radio. In any case, the pathfinder landing site leader makes sure that pathfinders mark the most dangerous obstacles first and, if possible, that they remove them.

b. If required to do so by the supported unit, pathfinders can mark initial assembly points for troops, equipment, and supplies. They should choose locations that help ensure the quick, efficient assembly and clearing of the helicopter site. If the unit will use the assembly areas, the ground unit commander selects their locations. If needed, supported ground unit soldiers go with the pathfinders to reconnoiter and mark the unit assembly areas, set up assembly aids, act as guides, and help with landing and unloading operations. Having this help ensures that the pathfinders can rapidly clear troops, supplies, and equipment from the landing points.

c. Pathfinders have a limited capability to secure a landing site. If they precede the initial assault elements into a landing site, soldiers from the supported ground unit could go with them for security.

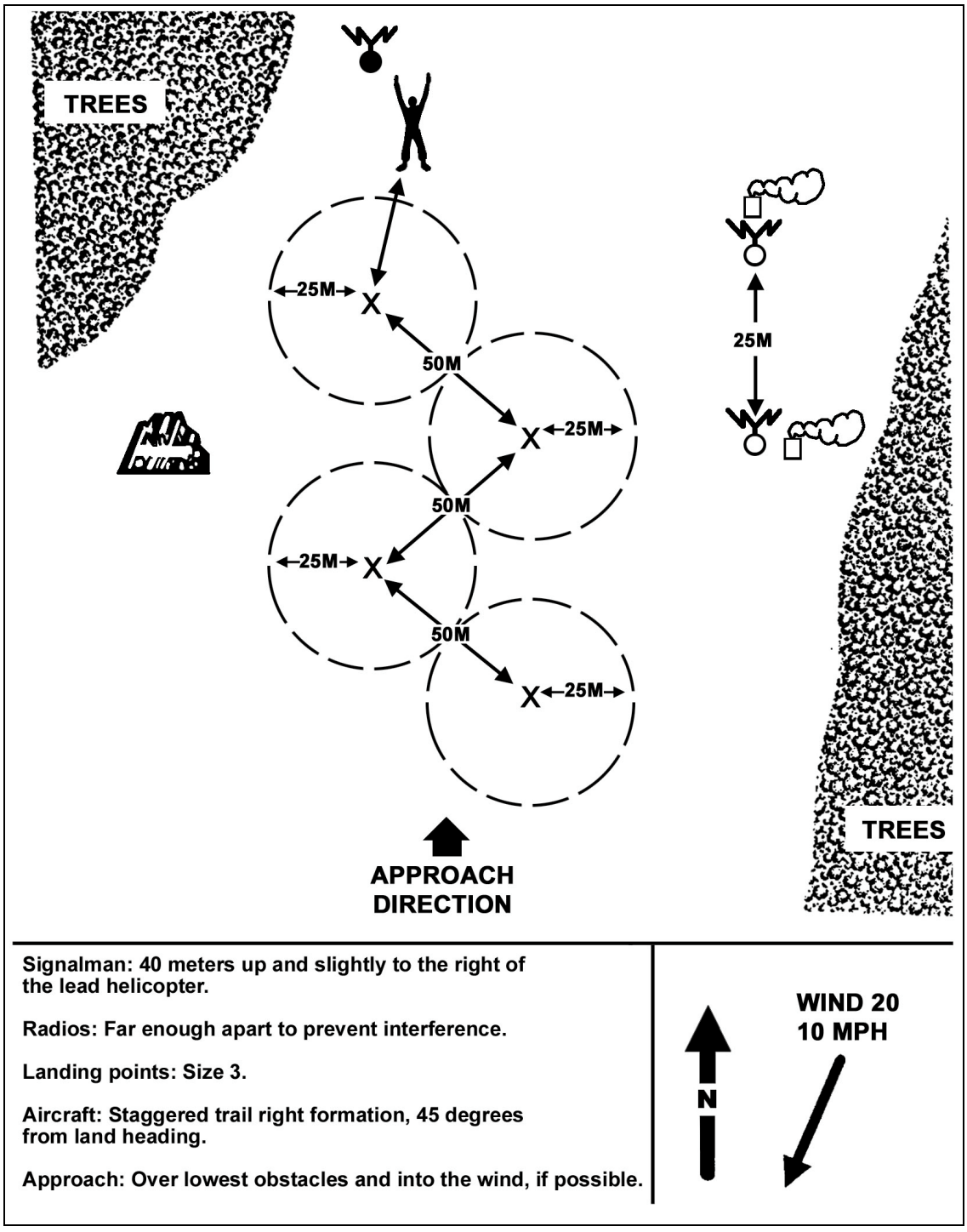

Figure 4-5. Helicopter day landing site, staggered trail-right formation.

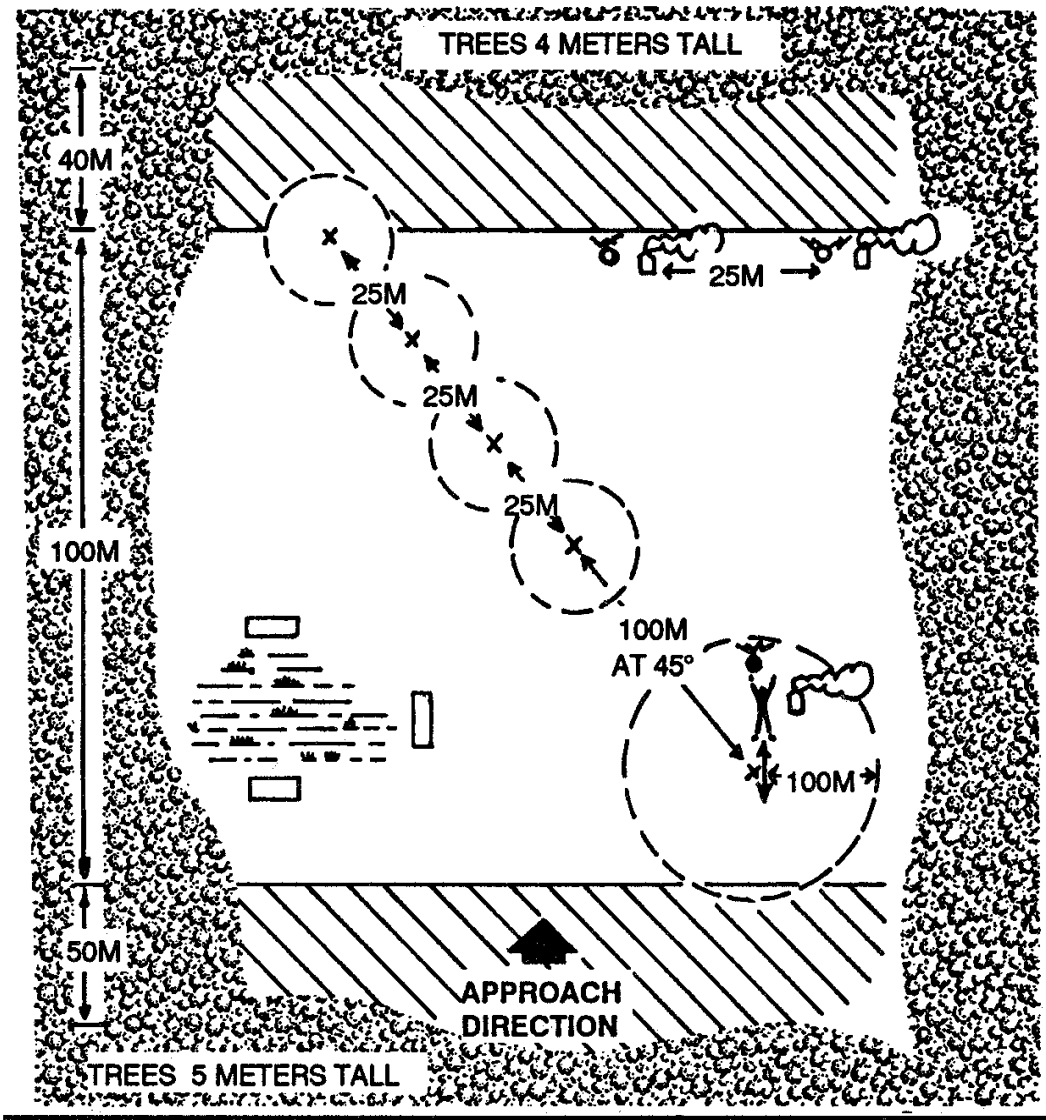

Figure 4-6. Helicopter day landing site, echelon right formation.

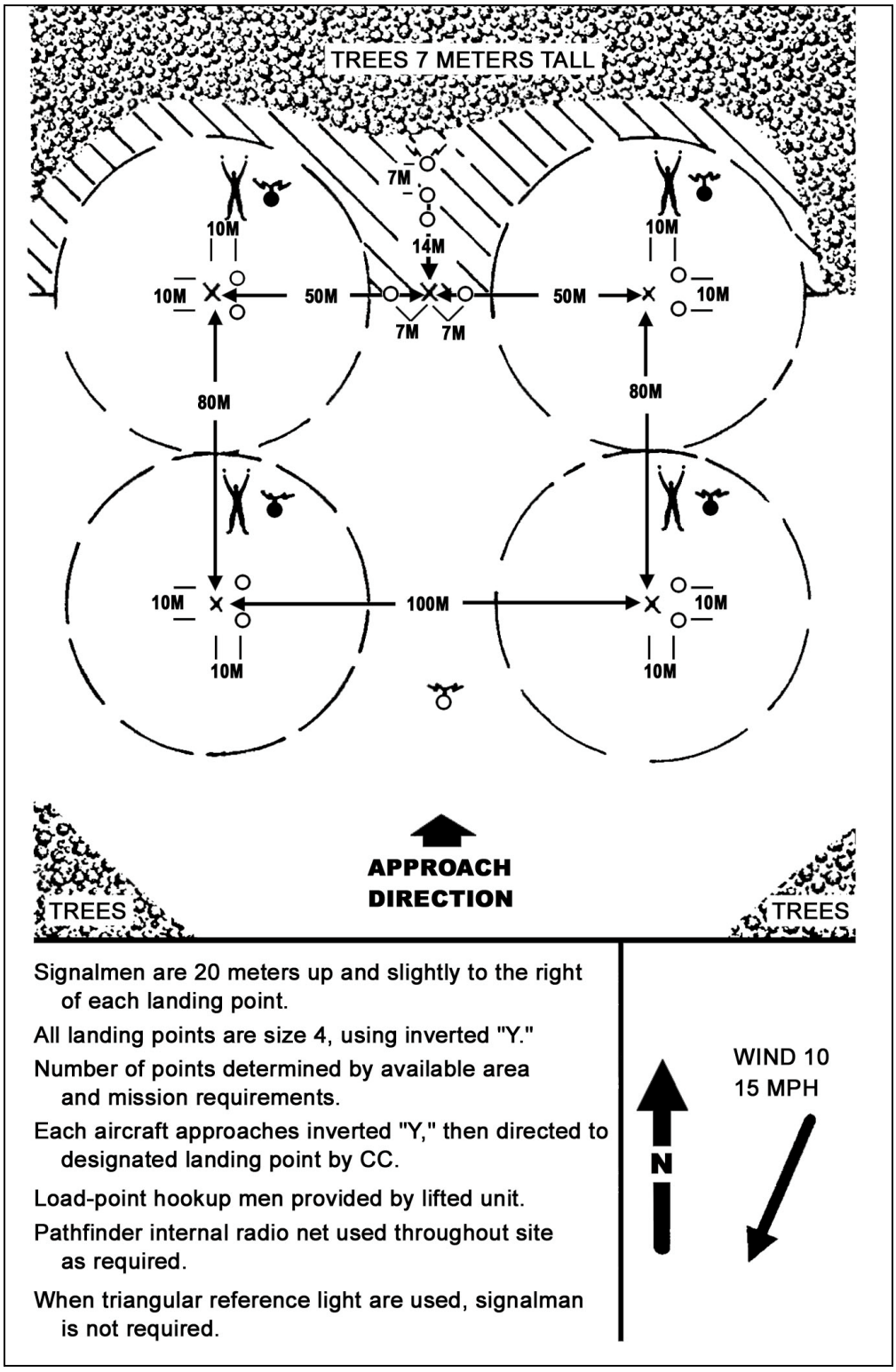

Figure 4-7. Day or night sling-load operation site.

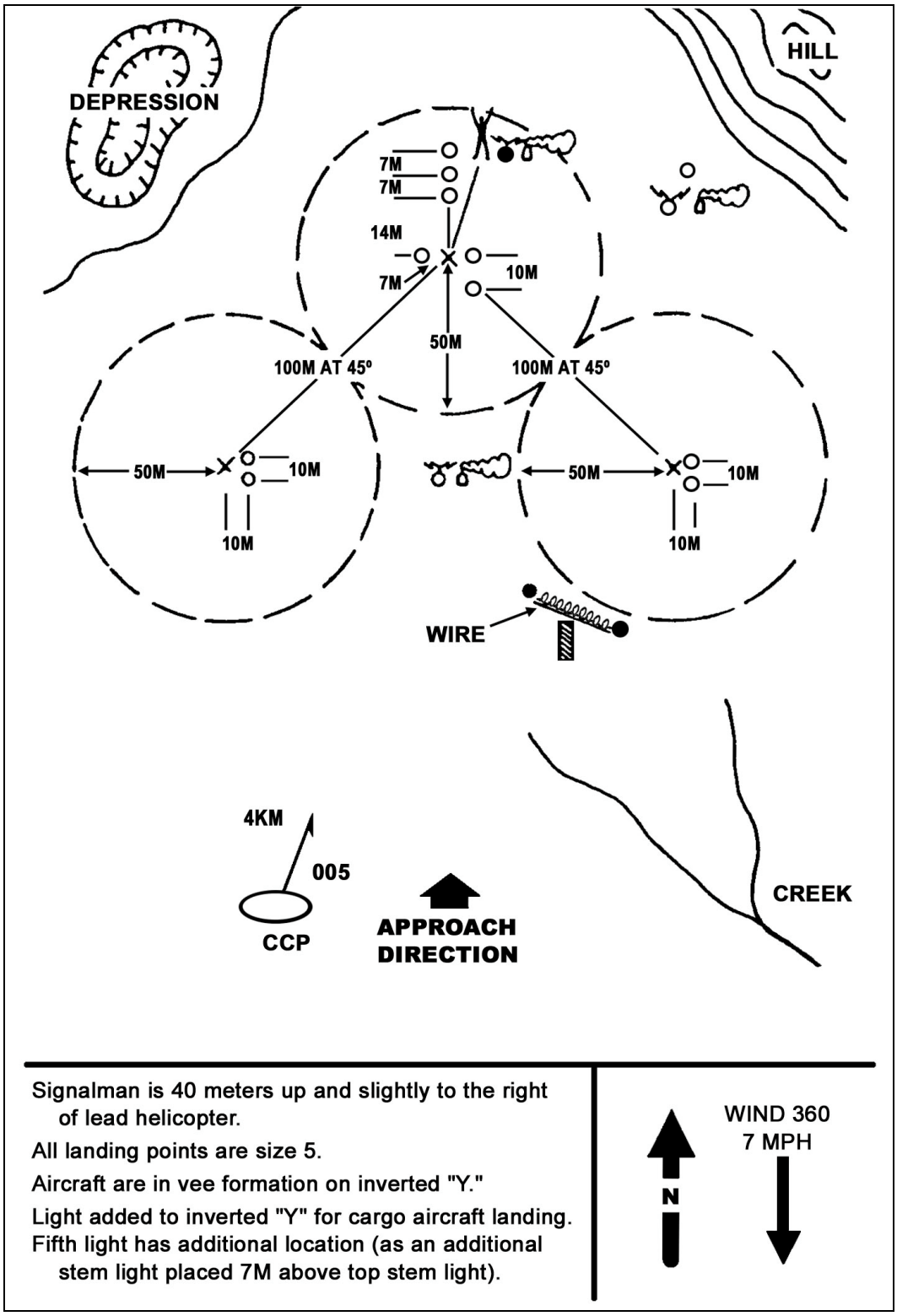

Figure 4-8. Day or night cargo landing site, "V" formation.

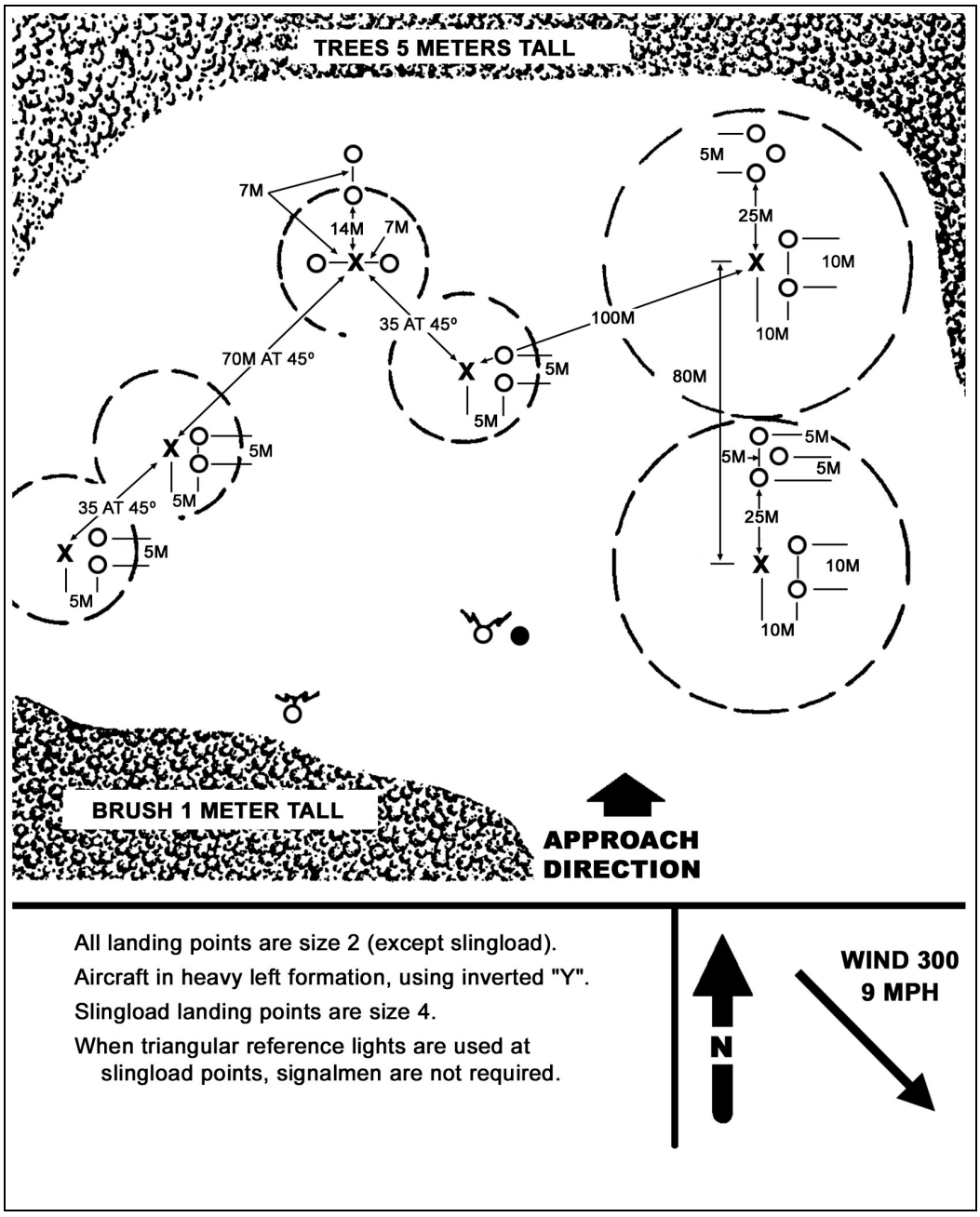

Figure 4-9. Night landing site with landing points for aircraft and sling loads.

4-10. INTERCEPT HEADING

The heading from the RP (or from CCP if the pathfinders do not use an RP) to the landing site coincides as closely as possible with the landing direction to keep the helicopter from having to turn sharply. The larger the formation, the more important this becomes. If a pilot cannot approach the landing site straight on, pathfinders will set up an intercept heading (Figure 4-12, page 4-18). They choose an intercept point far enough from touchdown to allow helicopters in formation a final approach of at least 1 to 2 miles. Flight leaders may need visual steering commands, time and distance information,

terrain features, and electronic or visual navigation aids to help them determine the intercept point and the landing direction at the landing site.

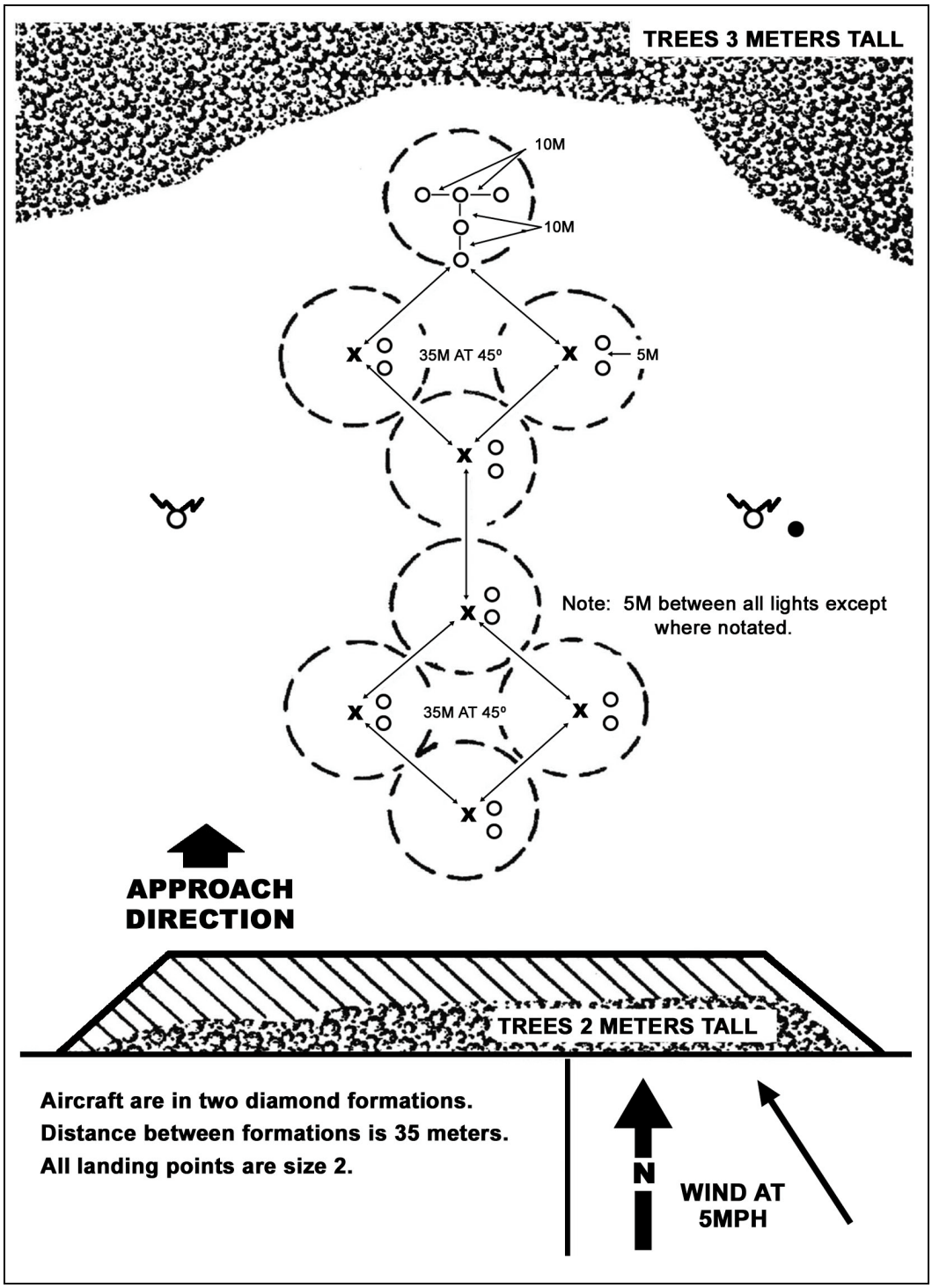

Figure 4-10. Utility helicopter night landing site, diamond formations.

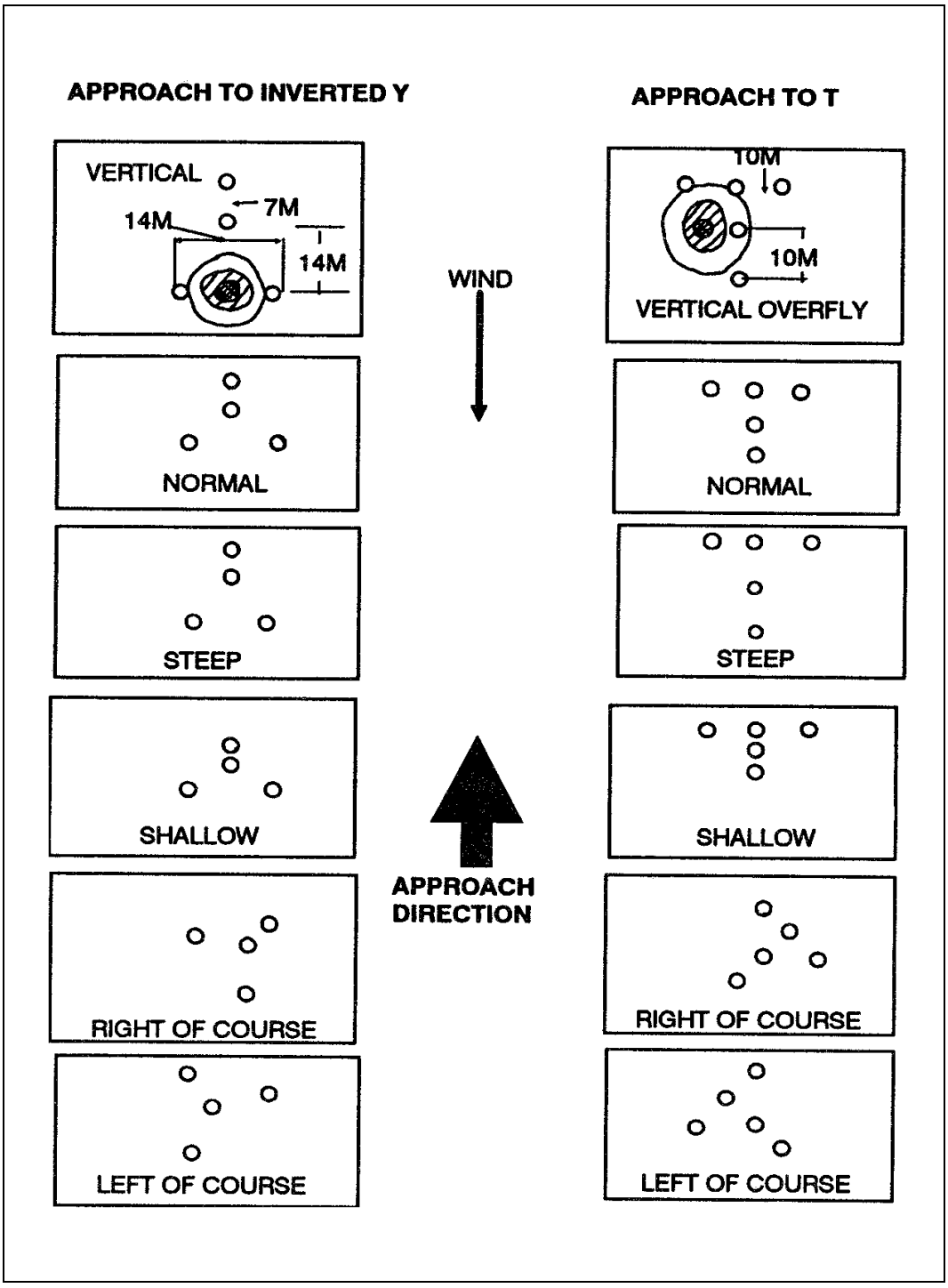

Figure 4-11. Lighted night landing symbols as the pilot would see them from different approach angles.

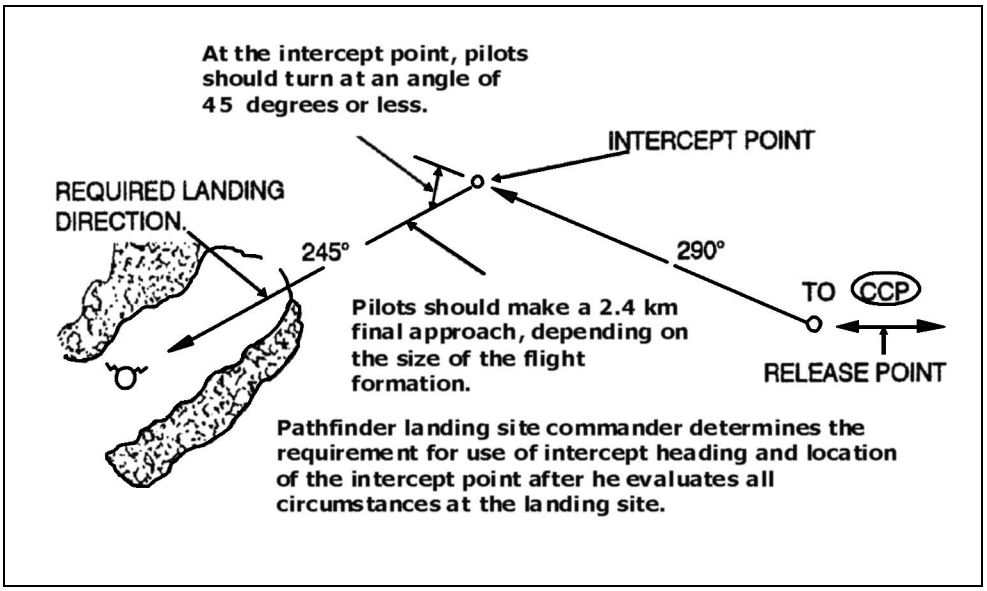

Figure 4-12. Intercept heading technique.

Section IV. LANDING ZONE OPERATIONS

Helicopters approach the LZ along a designated flight route. They normally travel in serials containing four or five helicopters, but they sometimes travel as platoon-sized lifts. One serial may contain a flight for each helicopter site. Flights of medium or heavy transport helicopters (CH-47), carrying artillery or other bulk cargo often arrive at LZs one or two helicopters at a time (Figure 4-13, page 4-19). Later flights follow at the smallest time intervals. These intervals depend on the number of helicopters in each flight, the configuration and conditions of the landing site, and the nature of the cargo to be loaded or unloaded. During planning, the aviation unit commander determines the time between successive flights. Once an operation starts, pathfinders at the site recommend any changes needed to ensure helicopter safety or expedite operations. Night operations often require more time and distance between formations.

4-11. COMMUNICATIONS CHECKPOINT

As each helicopter serial reaches the communications checkpoint (CCP) on the flight route, the flight leader contacts the appropriate helicopter landing site control center.

a. The CC then gives the flight leader the heading from the CCP to the landing site, the landing direction, and other relevant and important information, as follows:

- Enemy situation.
- Friendly fires.
- Field elevation.
- Landing formation.
- Terrain conditions.
- Traffic situation.
- Obstacles.
- Availability of smoke or light gun.
- Next reporting point.

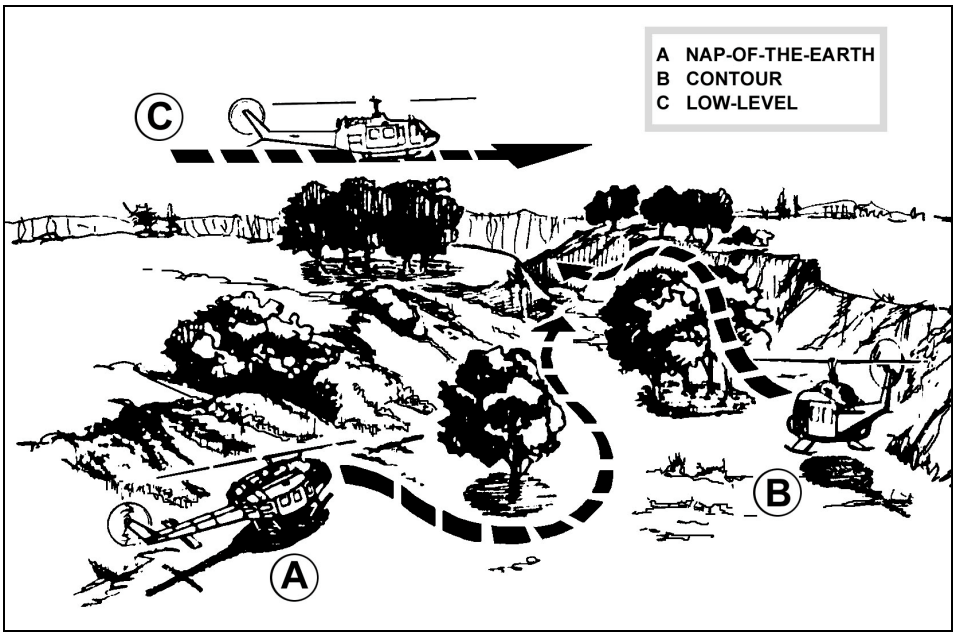

Figure 4-13. Flight techniques.

b. Before reaching the CCP, IAW instructions from the flight leader, all helicopters in a flight switch to the pathfinder control frequency.

NOTE: Pathfinders must stay prepared to provide ATC and navigational aid to all aircraft in and around the landing site, in case those aircraft have no specified flight plan.

c. The helicopter formation continues along the flight route to the RP. The electronic and visual aids at the RP (if manned) help pilots navigate. As each helicopter passes over or near the RP, its flight serial leader reports this to the respective landing site CC. Then the helicopter flies directly to the assigned landing site. The CC at the individual landing site uses visual signals, steering commands, or electronic homing techniques to help any flight that cannot find its landing site.

(1) ***Day Operation Signals***. For daylight operations, you can use different smoke colors for each landing site. You can use the same color more than once, just spread them out. Use smoke only if you have to, because the enemy can see it, too. Try to use it only when the pilot asks for help locating his helicopter site.

(2) ***Night Operation Signals***. For night operations, use pyrotechnics or other visual signals in lieu of smoke. As in daylight, red signals mean "DO NOT LAND," but you can also use it to indicate other emergency conditions. All concerned must plan and know emergency codes. Each flight lands at the assigned site according to CC messages and the visual aids displayed. You can use arm-and-hand signals to help control the landing, hovering, and parking of helicopters.

4-12. AIR CONTROL POINTS

Pathfinders might have to manage ACPs in order to help aircraft en route to the LZ.

a. The ACP party consists of two or three pathfinders, or at least one pathfinder and assistants. The party positions and operates electronic or visual navigation aids, or both.

The party also operate radios in the pathfinder internal net (if used) and the GTA net. The ACP party monitors the GTA net so they can respond at once to any pilot's request for help finding an ACP.

b. The ACP party installs navigation aids as soon as it arrives at the site or as planned. They try to set up all of the aids at the same time. However, if they cannot do this because they have too few people, or for some other reason, then they set them up in the following order:

(1) ***GTA Radio***. The party sets this up first. Then, if the aviation unit commander has asked them to do so, they install the electronic homing beacon. This beacon allows the party to offer long-range guidance. If they do use the beacon, the party sets it up far enough away to prevent excessive radio interference. This also helps keep the enemy from destroying the radios and the beacon at the same time.

(2) ***Visual Navigation Aids***. These navigation aids vary in number and type, depending on aviation unit SOPs and requirements and on the need for security. The ACP party removes any grass or brush that masks their usage of these aids, but they also plan a way to conceal the markings in case they sight enemy aircraft.

(3) ***Internal Net Recorder***. The pathfinder internal net recorder sets up communications with the landing zone CCs as fast as he can. He immediately reports the state of ACP readiness and any information about the local enemy situation, if any. Unless directed to operate a beacon on a definite time schedule, he constantly monitors the radio.

(4) ***Security Personnel***. The ACP party can include attached personnel from the supported units. These personnel provide security. They both move to their assigned locations and take up security positions, or they help set up and operate navigation aids and communications equipment.

Section V. NIGHT OPERATIONS

Daytime visual references (checkpoints for positive identification) are difficult to see at night. Visual aids for night navigation emit illumination. Having too few visual references can cause pilots to concentrate on a single light or group of lights in a concentrated area. This can cause visual illusions, which can then cause vertigo. To prevent this hazardous situation, pathfinders mark LZs with multiple lights and mark landing areas with two or more widely separated lights.

4-13. TACTICAL LANDING LIGHTS

The tactical landing light system provides visual cues for landing in a tactical landing site.

a. When the aircraft approaches from terrain flight altitudes, it should use the inverted "Y" system. Aircraft normally approach a tactical landing site without the aid of the search landing light. The lighting for a tactical LZ can consist of handheld flashlights or "beanbag" lights arranged on the ground.

b. Regardless of the type lighting device used, pathfinders identify the touchdown point with at least two lights. At night, they can designate different helicopter sites with lights of different colors. They may also use different colors to separate flights within a larger formation. A lighted (inverted) "Y" indicates the landing point of the lead helicopter (Figure 4-14, page 4-22).

c. At other touchdown points, helicopters land with the right landing gear or skid just to the left of the light (Figure 4-15, page 4-22). Until the last practical moment, pathfinders hood or turn upside down all lights for security. They also place a signalman at a sling-load point. Then, they beam the lights in the direction from which the helicopters approach.

(1) Pathfinders display an inverted "Y" for cargo aircraft. This marker consists of five lights. Pathfinders place the fifth light IAW prior coordination with the supporting aviation unit (Figure 4-16, page 4-22). The fifth light can go 7 meters from last stem light or 10 meters below right flank light.

(2) Pathfinders will display a NATO landing "T" if an aircraft approaches the LZ from 500 AGL or above, or anytime the pathfinders coordinate in advance with the supporting aviation unit.

(3) Noncargo aircraft require a 5-meter separation between touchdown point and lights, with a 5-meter separation between lights.

(4) Cargo aircraft require a 10-meter separation between touchdown point and lights, with a 10-meter separation between the lights.

d. During darkness, helicopters approach slightly steeper and slower than they would in daylight.

e. Vehicle headlights offer one kind of emergency night lighting. Pathfinders place two vehicles about 35 meters apart and 35 meters downwind of the landing point. They shine their headlights so that their beams intersect at the center of the landing point (Figure 4-17, page 4-22). The helicopter approaches into the wind, passes between the vehicles, and lands in the lighted area. This method does not work well for large helicopters.

CAUTION

When fully adapted to the night, the eyes grow extremely sensitive to any light. Sudden exposure to a light source causes partial to complete loss of night vision.

Thus, take care to avoid exposing pilots to light sources. Also, if pilots are using NVG, avoid shining a light directly at the aircraft, or use light sources compatible with the NVG.

4-14. EXTERNAL LOADS

Employing external loads presents a challenge in the dark. Even so, the pathfinder can use one of several methods. If he lacks sufficient signalmen, he marks the load by placing three reference lights 25 meters in front of the load. He spaces them in a triangle, 5 meters apart. This helps the flight crew during hookup, liftoff, and landing. On liftoff, the aircraft climbs vertically until the load clears the ground. As the helicopter begins to move forward, the pilot applies enough power to maintain a climb that allows the sling load to clear any obstacles on the liftoff path. The shorter the sling, the less altitude required to clear obstacles. To compute the distance required for departure clearance, the pathfinder adds sling length to obstacle height.

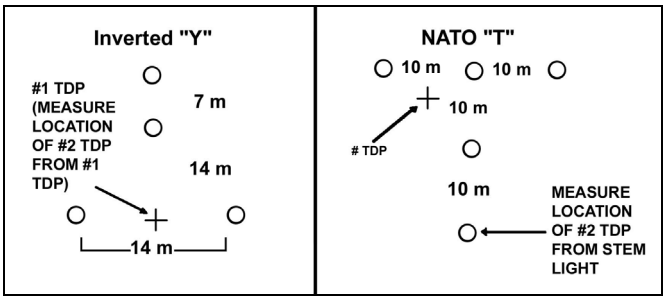

Figure 4-14. Placement of the Inverted "Y" or NATO "T" at the Number One Touchdown Point.

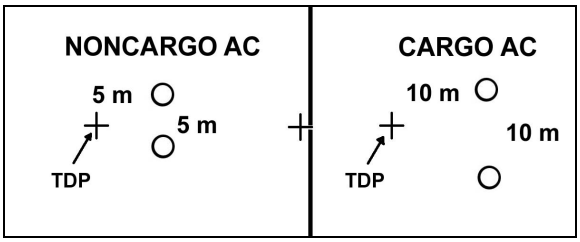

Figure 4-15. Placement of additional touchdown point markings for night use.

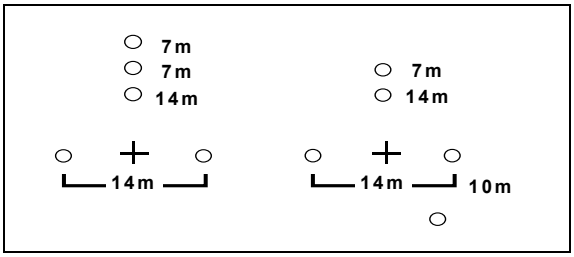

Figure 4-16. Placement of fifth light using inverted "Y," when coordinated.

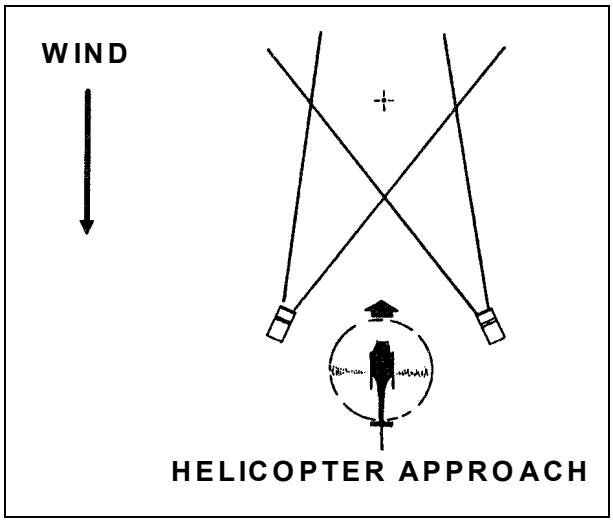

Figure 4-17. Emergency night lighting by vehicle headlights.

4-15. MULTIHELICOPTER OPERATIONS

Only by using NVG can pilots fly safely in formation in a complete blackout and at terrain flight altitudes.

4-16. NIGHT VISION GOGGLES

To operate at terrain flight altitudes during low- or mid-light levels, pathfinders use night vision goggles. Because the lights in the tactical lighting set are too bright for these goggles, pathfinders must place a filter over the clear lens cover. If they do not have filters, they can paint the lens covers or cover them with plastic tape to reduce the intensity of the light.

WARNING

When your unit trains with or employs the tactical light set, wear a filter over your night vision goggles to prevent eye injury. If you do not have a filter, paint the lens cover or cover it with plastic tape to reduce light intensity.

Section VI. ENVIRONMENTAL CONSIDERATIONS

The pathfinder unit can expect to support the aviation commander and ground unit commander in many climates and types of terrain. The requirements for establishing a landing site or zone are similar. For aircraft to land safely and quickly in challenging environments, pathfinders must choose and prepare LZs carefully.

4-17. PILOT INPUT

The pilot considers his experiences and his responsibilities to the crew and aircraft before determining whether a proposed landing site is safe.

a. Challenging climatic and terrain environments include extreme hot and cold weather and jungle, desert, and mountainous terrain. (For more detailed information on the climate, terrain, and operational aspects of these areas, see FM 90-3, FM 90-5, and FM 3-97.6 [90-6].)

b. Each area requires the pilot to know and follow special procedures. The pathfinder who also knows these procedures can better advise and assist aviators and the supported ground unit.

4-18. COLD WEATHER

Many parts of the world experience cold weather. Extreme cold and blowing snow pose special problems in ground operations and flight. Pathfinder mission planning includes considering the problems presented by ice, snow, or rain. The pathfinder's knowledge of flight procedures helps him advise the pilot about the existing surface conditions.

a. **Communications**. Most locations allow generally good radio communications. However, atmospheric electricity, such as the aurora borealis, can disrupt them. These events could disturb or block some frequencies. Mountainous terrain also restricts communications. Pathfinders may need to set up relay stations. "Radio skipping"

happens often in cold weather areas. RATELOs often hear long-distance radio traffic on tactical FM networks.

b. **Navigation**. In snow-covered areas with flat terrain, pilots may need marked and manned RPs. When aircraft fly over loose snow, the air movement lifts the snow and circulates it into a snow cloud. This often produces a zero-visibility condition known as "whiteout," through which the pilot must take off or land blind (Figure 4-18, page 4-26). Whiteout conditions place extra demands on the landing site party.

c. **Surface Conditions**. The pathfinder evaluates the surface of the ground to see whether aircraft can land without sinking too deep into the snow. He can use a tactical vehicle to test the hardness of the surface. The landing site party may also try to determine the degree of ground slope and whether or not obstacles lie under the cover of snow at each landing point.

(1) ***Distance Between Aircraft***. Pathfinders increase the distance between aircraft to 100 meters and the size of the landing point to 100 meters in diameter.

(2) ***Landing Point Markings***. Marking the landing points presents other problems. A pilot's depth perception is impaired in snow-covered areas. A signalman on the ground provides a useful reference for estimating height. In daytime, pathfinders mark touchdown points so the pilot can find a clear and safe landing area.

(3) ***Whiteouts***. If the tactical situation permits, the GTA radio operator advises the pilot of the surface conditions so the pilot can plan how to approach. Using the echelon left or right landing formation reduces the effect of snow clouds (also called "whiteouts") on subsequent landings. The pathfinder plans to stagger aircraft arrivals to let the snow clouds settle.

(4) ***Multiple Landing Sites***. Depending on the mission requirements, climatic conditions, and the expected times of the landings, the pathfinder leader may decide to use multiple landing sites.

(5) ***Night Approaches***. Aircraft making night approaches to snow sites need a visual reference point on the ground such as runway or tactical landing lights. These lights help the pilot judge the angle of descent and rate of closure. He plans the approach to land short of the touchdown point. This ensures that he does not overshoot the point and have to decelerate rapidly in the snow cloud produced by his own aircraft. Approaching short allows the pilot to maintain airspeed after leveling off, and to keep the aircraft in front of the snow cloud until touchdown.

(6) ***Adjustment of Inverted "Y."*** If he coordinates with the flight commander before the landing, the pathfinder can adjust his inverted "Y" forward 10 meters in front of his designated Number 1 touchdown point. This way, the landing site party takes advantage of all usable areas on the site.

d. **Signalman**. The pathfinder leader positions any extra personnel to act as signalmen for aircraft approaching other touchdown points. While aircraft approach and land, he makes sure that signalmen remain in safe areas. Other signalmen should also control the loading of personnel on the aircraft, as instructed by the crew chief or the crew. The technique for landing on snow with a sling load resembles other types of approach, but the pilot hovers at a higher altitude because of the load (A, Figure 4-18, page 4-26). He has a hard time judging the height of the sling load (the height above the ground) as it nears the snow surface. He relies on a signalman to keep him informed. To

avoid building up a snow cloud, the pilot puts the load on the ground as fast as he can (B, Figure 4-18, page 4-26).

e. **Sling Load Operations**. The CH-47 requires a sling length of at least 60 feet. Other aircraft allow a shorter sling. Normally an aircraft hovers during hookup and liftoff with a sling load. Doing this above snow produces a snow cloud (B, Figure 4-18, page 4-26). The pilot must expect this and plan for it. In fact, when operating over snow-covered terrain, the pilot can use the most common technique-hovering the helicopter over the load while the ground crew attaches the sling to the hook-or not.

(1) The pilot can land to the left of the load, but close enough for hookup personnel to attach the sling to it.

(2) When ready for liftoff, the pilot initiates a slow, vertical ascent with enough lateral movement to position the aircraft over the load (C, Figure 4-18, page 4-26). He continues a vertical ascent until the load has cleared the ground and he has conducted a hover-power check. When the load clears the ground, the pilot begins accelerating, and continues to climb.

WARNING

Rotor wash increases the risk of frostbite. Make sure you and anyone else on the ground dresses for the conditions and keeps or uses a face mask and goggles.

f. **Static Electricity**. During cold weather, static electricity creates serious problems. Moving an aircraft through the air, brushing snow and ice from an aircraft, or dragging steel cables over the snow can generate static electricity. During external load operations, aviators key the FM radio just before load pickup. This discharges the aircraft's static electrical charge. Because the charge rapidly builds up again, hookup personnel use a grounding device to avoid electrical shock (Chapter 6 provides additional information about the static probe).

g. **Safety**. Accumulated ice on aircraft structural and moving parts presents a danger to nearby ground personnel. The aircraft can accumulate ice up to three-quarters of an inch thick during flight in temperatures and altitudes where icing conditions exist. During flight at less extreme temperatures, this ice begins to loosen and fall off. Ice may shed while the helicopter loses altitude during the landing approach and during touchdown, and pieces of ice shed by the main rotor can fly outward as much as 300 feet. Ground personnel should stay a safe distance away from helicopters during landing and shutdown (after flight in icing conditions), and passengers should not exit until the rotor blades have stopped.

4-19. JUNGLE

Jungle areas impede military operations. Jungle areas promise heat, humidity, rainy seasons, and other weather conditions that reduce aircraft performance.

a. **Communications**. Jungle tends to obstruct military lines of communication. Thick vegetation, irregular terrain, and adverse atmospheric conditions screen radio transmissions. The ground or supported might have to use radio relays. They might also have to staff and mark the CCP. If communications are limited in range, pathfinders

might also have to provide GTA communications to advise and direct the pilot to the landing site.

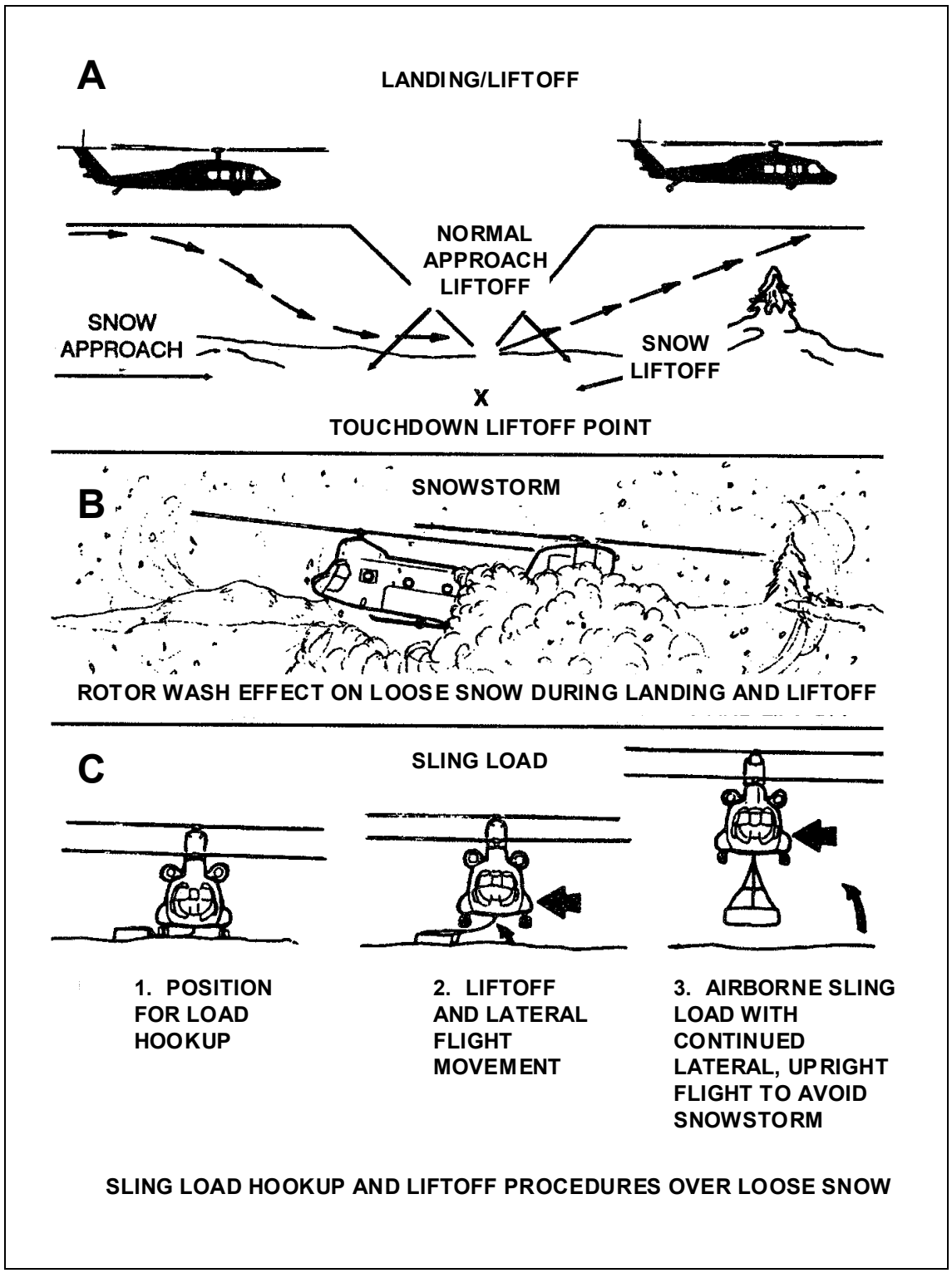

Figure 4-18. Lessening the effects of loose snow on the ground.

b. **Landing Sites**. Jungle conditions mean small landing sites that can handle only a few aircraft at a time. Small landing sites also mean a reduced allowable cargo load (ACL). Pathfinders evaluate surface conditions at the landing site to make sure the aircraft will not sink or bog down in the soil. Then, they survey the site for vines, trees, and other obstructions in the approach path and near the touchdown point.

c. **Navigation**. On an approach to a jungle landing site, the pilot avoids using a high rate of descent. He uses a steep enough angle of descent to just clear any obstacles. He normally uses a ten-to-one obstacle ratio, but for a jungle operation, he should reduce this ratio to no less than five to one. Due to density altitude problems in tropical areas, the aircraft may not be able to develop enough lift to clear tall obstacles. So, the pathfinder leader considers obstacle height on the approach and departure ends. When site size and terrain conditions permit, the pilot might run the liftoffs and landings. However, the small size of a jungle site, soft terrain, or obstacles can keep him from doing so.

d. **Lights**. The tactical situation may restrict the use of lights in nighttime jungle LZ operations.

e. **Security**. Success of the ground unit commander's mission relies on site security. Because jungle terrain provides cover and concealment, landing site security presents a constant challenge. The pathfinder team leader coordinates with the flight commander to set a specific time to light the site.

f. **Liftoffs and Landings**. The pathfinder orients the site to the direction of the wind. He keeps departure obstacle ratios low due to climatic conditions, jungle vegetation, and helicopter's reduced lift capability. Since ground effects reduce the aircraft's lift efficiency, the pilot hovers as low as possible and lingers no longer than necessary.

4-20. DESERT

The typical desert is a dry, barren region, generally treeless and sandy. It suffers environmental extremes, with violent and unpredictable weather changes. Its terrain conforms to no particular model. Frequent clear days offer unequaled visibility and flight conditions, but a sudden sandstorm immediately halts all operations. Successful desert operations require special training, acclimatization, and great self-discipline.

a. **Communications**. In desert operations, the radio offers the best way to communicate. The low, rolling terrain allows good radio range. Due to the increased distances involved in military desert operations, FM radio communications may prove inadequate, especially in the higher FM frequencies. Pathfinders, aircraft, and ground crew must all have high-frequency radio equipment. Sand or dust in equipment or a poor electrical ground cause most communication problems. Due to the increased distances between land force units engaged in desert operations, helicopters may provide air or ground relay or help deploy ground radio rebroadcast facilities.

b. **Navigation**. Many of the conditions experienced in cold weather operations resemble those in desert operations. Pathfinders and pilots find distances and altitudes hard to judge in the desert. The lack of definable terrain features makes navigation difficult, especially at night and over long distances. Also, the sameness of the terrain can influence a pilot to pay less attention to his surroundings. Pathfinders may have to mark and man release points.

c. **Landing Sites**. The climatic conditions in the desert profoundly affect the setup and operation of landing sites. Most importantly, the pathfinder must consider density

altitude, wind, and sand (dust). Sand on a landing site can produce brownout conditions similar to those in snowy areas, so the same precautions apply. This makes a rocky area a better landing site than a sandy hollow, depression, or valley.

d. **Wind**. Desert winds generally calm down for an hour or two around sundown. Another calm occurs before sunrise. Other than those times, desert winds can drive dense clouds of dust and sand with hurricane force. Strong winds naturally raise dense clouds of dust and sand, and rapid temperature changes often follow strong winds. The pathfinder leader must consider what times of day the wind will allow him to operate the landing site.

(1) The extreme heat often experienced in the desert also affects the aircraft's ACL. When supporting a ground unit, the pathfinder leader coordinates with the aviation element to determine the ACL for each type of aircraft. Both the minimum distance between aircraft and the size of the landing point increase in desert operations: 100 meters between aircraft, 100-meter-diameter landing points. In daylight hours, ground crew members mark the touchdown points. They paint sandbags a bright color or mark them using some other quick method. Ideally, they use signalmen.

(2) When establishing a landing site, the pathfinder leader considers taxi procedures. When an aircraft must taxi, the pilot moves it into a vertical position as quickly as possible to reduce the amount of sand (dust) the engine sucks in as well as to avoid a brownout. Pilots should avoid taxiing over the same area repeatedly.

e. **Liftoffs**. Pilots will not try a normal liftoff in a sandstorm. Helicopters with wheels and airplanes should make a running-type takeoff. Helicopters with skids should make a maximum performance liftoff.

f. **Landings**. When they can, pilots should use a running-type landing to reduce sand intake. If a pilot can make a running landing, he keeps the touchdown roll to a minimum to keep from overloading the landing gear. If the terrain does not permit a running landing, the pilot lands at a greater than normal angle. He should never land from a hover.

g. **Safety**. Ground crew personnel should wear clothing that will protect them against the sand blown around by the rotor wash. Each person on the ground should take special care to keep the sand out of his eyes, ears, nose, and mouth. Goggles, earplugs, and cloth masks provide adequate protection for facial areas. Other ground crew procedures resemble those for cold weather operations.

4-21. MOUNTAINS

Mountains have rugged, divided terrain with steep slopes and few natural or man-made lines of communication. Weather fluctuates seasonally from extreme cold, with ice and snow, to extreme heat. Also, it can switch between the two extremes very quickly. This unpredictability greatly affects operations.

a. **Communications**. Mountainous terrain often limits or restricts communications. To maintain communications within the AO, aircraft may have to limit operations to the vicinity of the unit. Other aircraft can serve as radio relay stations. Pathfinder units may also have to set up radio relays at the RP, CCP, or both.

(1) Mountain conditions challenge aviators in pathfinder operations more than any other conditions. For precise flying in mountainous areas, pilots need large-scale terrain maps.

(2) Since intervening terrain degrades GTA communications, providing navigational aid and control over extended ranges might prove difficult.

b. **Wind**. The main weather hazard in the mountains is wind. Even moderate winds (11 to 20 knots) can produce significant turbulence over mountain ridges. Predicting wind conditions is difficult. The windward side of a mountain maintains a steady direction of airflow, though the strength of the wind may vary. The leeward side has turbulent winds with strong vertical currents. This turbulence might prevent assault landings and require pilots to fly at higher altitudes. This naturally increases the risk of detection and destruction.

c. **Density Altitude**. In the mountains, density altitude can vary a lot between PZs and LZs. It can also vary greatly from one time of day to another. It normally peaks in the late afternoon, and drops to its lowest point at dawn.

d. **Navigation**. In the mountains, the helicopter offers the best way to rapidly move forces. In the offense, air assault operations can insert forces into the enemy's rear area and bypass or envelop his defenses. In the defense, helicopters can move reinforcements and reserves rapidly.

e. **Landing Sites**. Mountainous regions offer few, if any airfields for fixed-wing aircraft, and few LZs suitable for multiple helicopters.

(1) If the enemy situation allows, pathfinders set up LZs on the windward side of the mountain, since that side offers more stable winds.

(2) When they can only find LZs designed for single aircraft, planners increase in-flight spacing. This places an extra load on each crew. When conducting multiship operations into a small LZ, the pathfinder controller should allow sufficient time between liftoff and landing for the turbulent air generated during the departure of the previous helicopter to stabilize. Otherwise, the pilot of the incoming craft will experience that turbulence and lose lift.

(3) A pilot must touch down very carefully on the typical small, rough, sloped mountain LZ. Depending on the angle of the slope and on the aircraft's available torque, the pilot might be able to make a normal slope landing. Pilots of larger craft, such as cargo helicopters, may have trouble positioning the entire fuselage in the available area. Once the cockpit extends over the landing area, the pilot cannot see the ground. He must rely on the crew chief and signalman to direct him.

(4) During a mountain approach to an LZ surrounded by uneven terrain, the pilot has a hard time determining the actual aircraft altitude and rate of closure. Where the terrain slopes up to the LZ, a visual illusion occurs. The pilot may think he is flying too high and closing too slowly. If the terrain slopes down to the LZ, he may feel he is flying too low and closing too fast. Employing a signalman on the ground gives the pilot a visual reference to adjust his controls. He may need more than one signalman.

f. **Site Assessment**. Pathfinders should determine the following information while reconnoitering and selecting a mountain site:

(1) The size, slope, amount of surface debris, and the area covered by shadows and obstacles in and around the site.

(2) The approximate direction, speed, and characteristics of the wind.

(3) The inbound route, if necessary. When the pilot cannot land due to a steep slope, the aircraft may terminate at a hover to off-load troops and supplies.

(4) The departure route. Departure routes should orient into the wind and over the lowest obstacles.

Section VII. APPROACH PATH CONSIDERATIONS

Pilots should try to land their aircraft into the wind; however, the terrain and its effect on the wind may require a crosswind landing. If so, the pilot for single-rotor helicopters should plan the approach so that the wind blows from the left side of the aircraft. This helps the pilot overcome the effects of torque, reduces power requirements, and helps him control the heading. Other considerations include vertical air currents, escape routes, terrain contour and obstacles, and the position of the sun.

4-22. VERTICAL AIR CURRENTS

Updrafts on the approach path make landing easier. However, severe vertical air currents (updrafts or downdrafts) may require the pilot to approach downwind.

4-23. ESCAPE ROUTES

The pathfinders and pilots should plan one or more escape routes along the approach path for the pilot to use if he must go around and try the approach again.

4-24. TERRAIN CONTOUR AND OBSTACLES

The height of terrain and obstacles along the approach path should permit the pilot to conduct a shallow approach angle into the landing site. When possible, the pathfinders select a landing point on or near the highest terrain feature.

4-25. POSITION OF THE SUN

Though the pilot first considers wind direction and nature of the terrain when choosing the approach path, he must also consider the location of the sun and shade relative to the approach path. To keep the pilot from having to adjust from one light condition to another, the pathfinder makes sure that if the landing point falls in a shaded spot, that the whole approach path also does. When the sun rises or falls to just above the horizon, avoid using an approach path that faces directly into it.